Benchmarking international construction costs

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Benchmarking International Construction Costs

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Introduction

The title of this chapter reflects a preoccupation for practitioners, clients, economists, academics and government departments over many years, namely comparing the cost of construction in one country with the cost of construction in another. It is not just a simple matter of converting actual and/or estimated costs at a given date from one country to another through the use of currency exchange rates. Even within countries, different regions or cities will display variations in labour, material and plant costs, productivity ranges based on the availability of resources (including transportation distances) and contractor margins that take heed of market conditions. Furthermore, standards of construction, statutory requirements, local practices and concern for worker health and safety can impact on costs. Collectively, benchmarking international construction costs with a view to identifying value and performance is, and always has been, problematic (Best and Meikle, 2016).

The purpose of this chapter is to shed some light on the various conversion methods that are available for use and, objectively, make recommendations on which method(s) should be commonly adopted in practice. The routine approach for international benchmarking is to convert construction costs into US dollars (USD), so that at least all costs are in the same currency. Most practitioners appear to do this. Yet currency rates can be quite volatile, and therefore conclusions will depend to some extent on the timing of the study.

Purchasing power parity (PPP) is an alternative to currency conversion. The concept has been around since the 16th Century, but was developed into its modern form by Gustav (1918), and used by economists ever since. It assumes that, in the absence of transaction costs and official trade barriers, identical goods will have the same price in different markets when the prices are expressed in a given currency (Krugman *et al.*, 2010). Where this

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doesn't occur, the conclusion is that different countries have different domestic purchasing power.

The use of PPP as an alternative to traditional currency exchange rates is generally regarded as a superior approach (e.g. Rogoff, 1996; Langston and Best, 2005). PPP is an attempt to measure the economic wellbeing of people according to the country in which they reside. While not pretending to be an indicator of living standards, it does reflect the cost of living in-country and therefore forms a new baseline against which construction costs can be interpreted.

PPPs are defined as exchange rates that replace traditional currency exchange rates by taking into account the differences in prices between countries (Pakko and Pollard, 2003). They convert local costs into 'international dollars' compared to a nominated base country. The philosophy behind PPPs is the *Law of One Price* – namely that the cost of a good or service should be the same in different countries – else people would buy goods cheaper from one country and sell them at a profit in another (Baffes, 1991). However, whether the *Law of One Price* holds for any particular item depends on the item meeting four basic criteria (UBS, 2003). They are:

1. The item must be tradable
2. There are no impediments to trade
3. There are no transaction costs (such as transport) involved in trade of the item
4. The item is perfectly homogeneous across all locations.

If all four criteria are met then the price of the item should be the same in different places at the same time. In that case the cost of an item in currency X should represent the same value as the cost of the same item in currency Y (Best, 2008).

The United Nations sponsored International Comparison Program (ICP) commenced in 1967 and now produces PPPs published by The World Bank Group for most countries on an approximate three-year cycle. These indices have been interpreted and extended to form the Penn World Table (PWT) produced by the University of Pennsylvania. The Eurostat-

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OECD joint program currently collects more detailed PPP data than the ICP, but for a much smaller set of countries. Indices for both ICP and Eurostat-OECD PPPs are expressed as a proportion of per capita gross domestic product. The Union Bank of Switzerland (UBS) has also been producing PPP data since 1970, again approximately on a three-year cycle. They use a basket of goods and services and express their data in three forms (using a base for Switzerland, United States or the Euro-zone respectively). One criticism of these programs is the time delay between data collection and publication. Another criticism is the cost of the process (Langston and Best, 2005). These PPPs relate to a country and tend to ignore the differences that exist between regions or cities within national borders.

Over the last decade or so, attention has turned to the development of indices that are industry-focused, and more recently data has been compiled related to particular cities. Turner and Townsend, a large multi-national firm of quantity surveyors and project consultants, published surveys of international construction costs since 2009 comprising local prices and conversion to USD. In 2013, for the first time, they additionally presented cost data in the form of PPPs based on a new 'exchange rate' called *citiBLOC*, which was developed as part of a major study of 337 high-rise projects of 20 storeys or more (completed between 2003 and 2012) throughout the five largest cities in Australia and the United States, representing two-thirds of the known population of such buildings in these locations (Langston, 2014). By pricing a representative basket of construction-related items covering labour, material and plant, a standard basket price in each city (in local currency terms) can be determined. The cost of this basket equals one *citiBLOC*. Thereafter, the cost of a project can be divided by the cost of the basket to obtain the equivalent number of baskets required to pay for the construction. Although the unit of measure is 'baskets', not currency, the answer is a comparative index that has no geographical boundaries. For example, if Project A in Los Angeles was 5 baskets/m^2 and Project B in New Delhi was 4 baskets/m^2, then the construction cost in Los Angeles would be 25% more than New Delhi.

The *citiBLOC* approach grew alongside Turner and Townsend's surveys to effectively become an international locality index at the granularity of cities. Table 1 illustrates the approach for Sydney, Australia.

Insert Table 1 here …

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Perhaps the best way to describe PPP-adjusted values is to say that they express local prices in terms of purchasing power by weighting them according to a standard basket of relevant construction items (comprising common material, labour and plant items) that are made or otherwise available in-country. Imported goods and services should be avoided. The higher the PPP-adjusted value, the higher are the relative costs of building in one location over another.

Langston and Best (2005) first used the coefficient of variation (CoV) as a test for the *Law of One Price*. The thinking was that the method with the lowest CoV best reflected purchasing parity. They compared general PPPs produced by UBS and the World Bank, as well as USD currency conversion and the Big Mac Index. They found the latter was as good as any other method in some cities, but not in others. Hong Kong was a case in point, where the price of the Big Mac was about half of its expected value. This highlighted that the hamburger is not really a standard commodity across the world, but if one could be found there would be some confidence that its use in international cost comparisons would be superior to more costly and time-consuming methods. Large discrepancies were also found between the more established indices, particularly over the accuracy of the ICP data for Bangkok. Exchange rates were generally more volatile and displayed the greatest dispersion, suggesting that PPPs were more appropriate for use in practice.

Langston (2016) extended the notion of CoV testing by applying it to the data publicly available in Turner and Townsend (2013). Five different exchange rates were investigated, based on labour and material prices, composite prices, *citiBLOC* indices, the Big Mac Index and USD currency conversion respectively. He found that across the 23 surveyed cities, *citiBLOC* had the lowest CoV and hence better modelled the *Law of One Price* (i.e. where CoV theoretically equals zero).

Method

Turner and Townsend (2018) is the latest survey of construction prices, and embraces 46 cities. Over the last five years, they have used an identical framework for presenting their data. This makes it possible to objectively compare 2013 and 2018 costs and to see if the same conclusions reported in Langston (2016) can be replicated. The updated investigation

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doubles the number of cities, as can be observed in Table 2. Cities are ranked herein according to their cost of living using information compiled independently via the Expatistan website (https://www.expatistan.com/cost-of-living). The higher the index the more expensive is the cost of living in a particular city compared to a nominated base (set in this study as Sydney, Australia).

Insert Table 2 here …

The first phase of the investigation compares USD and *citiBLOC* PPP exchange rates. As was done previously, three types of construction cost data are again used. Mean cost/m^2 for various building types (comprising residential, commercial, industrial, retail, hotels, hospitals, schools, carparks and airports) are compared. Then, unit rates for labour, material and plant are compared. Finally, unit rates for composite work items comprising a mix of supply and install activities are compared.

CoV is calculated as standard deviation divided by mean, and expressed as a percentage. Values below 20% typically demonstrate very low variance, values between 20 and 50% are considered good given the nature of the base data, while values over 50% suggest the prices are either erroneous or heterogeneous.

The second phase of the study compares five different exchange rates. As was done previously, a basket of labour and material unit rates (*L+M*), a basket of composite work items (*Composite*), a basket of equally weighted labour, material and plant costs (*citiBLOC*), a McDonalds hamburger index (*Big Mac*) and USD exchange rates (*Currency*) are explored in turn.

Results

In the first instance, average construction prices for various building types in each city, expressed in both USD and PPP terms per square metre of gross floor area, are used to determine CoV. Table 3 shows these building types and computes the CoV across two datasets matching cities common with Turner and Townsend (2013) and extended in Turner and Townsend (2018). Langston (2016) previously found that of the 27 building types listed, 25 of them (i.e. 93%) had a CoV that is lower for *citiBLOC* PPP than USD conversion. This is

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observed to increase to 100% (for both n=23 and n=46) using 2018 data. Again, all but one of these values has a CoV between 20 and 50%.

Insert Table 3 here …

A range of labour, material and plant items in each city is similarly used to determine CoV. The results are provided in Table 4. Langston (2016) previously found that of the 17 items listed, 12 of them (i.e. 71%) had a CoV that is lower for *citiBLOC* PPP than USD conversion. This is observed to be 100% for labour and plant, and 63.64% (n=23) and 36.36% (n=46) for material using 2018 data. However, over half of the items had a CoV between 50% and 100%, indicating higher volatility at this level of work breakdown. The reason material prices favour USD over PPP conversion is suspected to be due to the larger proportion of cities from developing countries in the extended database (n=46) that have a higher reliance on imported construction products with embodied foreign labour in their manufacture.

Insert Table 4 here …

Finally, a range of composite items (i.e. involving supply and install activities) in each city is similarly used to determine the CoV. These outcomes are contained in Table 5. Langston (2016) previously found that of the 19 items listed, 14 of them (i.e. 74%) have a CoV that is lower for *citiBLOC* PPP than USD conversion. This is observed to be 73.68% (n=23) and 84.21% (n=46) using 2018 data. The majority of items had CoVs between 20% and 50%.

Insert Table 5 here …

Overall, PPP-adjusted prices have lower CoVs than USD-adjusted prices, and therefore adhere more closely to the *Law of One Price*. Currency conversion, on the other hand, generally has higher CoVs, and although the approach is still valid when pricing construction works located in another country, it is not appropriate when benchmarking international project cost performance.

PPP is shown to be preferable compared to currency conversion. But *citiBLOC* PPP is not the only choice available. Three further PPP methods are added, so a total of five cost conversions strategies can be compared against each other. Once again, the method with the lowest CoV represents the best available option.

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The L+M PPP is calculated based on local prices for the 5 labour items and the 11 material items provided earlier in Table 4. Labour and material are combined using the proportion of labour and material costs in each *citiBLOC* (plant cost is distributed evenly between them). Similarly, a composite PPP is calculated based on local prices for the 19 items provided earlier in Table 5. Finally, prices for a McDonalds Big Mac hamburger (considered a default global commodity) are used to provide a non-construction alternative, sourced largely from https://www.economist.com/content/big-mac-index.

An equivalent cost/m^2 for buildings in each city is computed by taking the mean local price for each of the categories listed in Table 3 (i.e. residential, commercial, industrial, retail, hotels, hospitals, schools, carparks and airports). While it is obvious that this resultant cost/m^2 does not apply to any particular building type, the average of all types is done so as to add more stability to the accuracy of in-country prices. This cost/m^2 is then divided by the relative PPP (i.e. L+M, Composite, *citiBLOC*, Big Mac and Currency, compared to the base for Sydney of 1). The results are shown in Table 6 (n=23) and Table 7 (n=46). Each is categorised into upper (25%), middle (50%) and lower (25%) quartiles using the indices from Expatistan (listed earlier in Table 2) that depict a cost of living from expensive (San Francisco = 1.16) to good value (Istanbul = 0.62).

Insert Table 6 here …

Insert Table 7 here …

Table 8 summarises the comparison of methods, and as previously discovered in Langston (2016), clearly shows that *citiBLOC* has the lowest CoV for both n=23 and n=46 datasets. In fact, the difference between the two datasets is negligible. However, only *citiBLOC* falls below the maximum target based on the mean CoV of the five conversion methods for each city. Ignoring the outlier for Big Mac in Hong Kong, currency conversion has the highest values for CoV, range and comparison to base. When subdivided into expensive (upper quartile), mid-range (middle quartile) and good value (lower quartile), the CoV for *citiBLOC* is even lower – averaging close to or under 20% (see Table 9).

Insert Table 8 here …

Insert Table 9 here …

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Discussion

Focusing further on the *citiBLOC* indices, it can be seen that each of upper, middle and lower quartile data compute a regression line (line of best fit) that is quite flat. There is considerable volatility and a low r^2 value in each case, which may have more to do with the accuracy of Expatistan's cost of living index used to rank the cities. Each quartile is presented in Figure 1 (n=23 and n=46).

Insert Figure 1 here …

Figure 2 graphically illustrates index volatility of the equivalent cost/m^2 values for each of the 46 cities in Turner and Townsend (2018). They are listed in order of decreasing cost of living from left to right. The overall trend lines for cost/m^2 generally decline in keeping with the cost of living, and the reason *citiBLOC* has the lowest CoV is probably because this method is the best at smoothing out the data. This is because mean cost/m^2 (in local currency) divided by a balanced cost/basket of local commodities (also in local currency) produces a more stable ratio (i.e. basket/m^2). Cost effectively cancels out, as does currency conversion. Resultant variations are therefore reflecting other differences between locations, such as productivity levels, contractor margins, standards of construction, statutory requirements, local practices and concern for worker health and safety.

Insert Figure 2 here …

One of the big differences between cities in this study is the cost of labour. Using the data in Table 4, the ratio of labour to material in the L+M PPP can be computed. This varies from 55:45 (Zurich) to 8:92 (Bogatá). The mean ratio across all cities is 27:73 (n=23) and 30:70 (n=46). High labour-cost and low labour-cost cities have been shaded differently in Figure 2 earlier. Not all low labour-cost cities have lower values for cost of living, with Hong Kong, Singapore, Doha and Dubai/Abu Dhabi being notable examples. However, all cities in the lower quartile (n=23 and n=46) deploy cheap labour in construction (mean ratio is 15:85 in both cases).

Finally, it should be noted that any city can be selected as the base. Turner and Townsend (2013) used Sydney, as does this study, but later surveys changed the base to London. The choice of base has no effect on the conclusions reached herein.

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Conclusion

The conclusion from Langston (2016:74) stated that:

> *Construction project costs between countries cannot be compared reliably using currency exchange rates, as this fails to take account of the local cost of living. The citiBLOC PPP uses a standard basket of 10 construction items, comprising notional 50% material, 40% labour and 10% plant, to calculate PPP values in each city. The average price of items in the standard basket for a particular city is then divided by the average price for a base city to calculate relative PPPs. When benchmarking international project cost performance, making relative cost comparisons between cities in different countries is necessary. PPP is the correct methodology to apply.*
>
> *This paper demonstrates that citiBLOC PPPs have the lowest CoV of any of the five methods investigated, and using the Law of One Price as the test, certainly out-perform currency conversion in terms of lower volatility. Given that most practitioners still use USD currency conversion to draw conclusions about relative cost performance in different locations, it seems that many of their conclusions may be unreliable or erroneous. While presentation of construction project costs in terms of USD or other standard currency has its place, citiBLOC PPP is the preferred method whenever judgements about relative project cost performance are involved.*

Exactly the same conclusion can now be drawn from the 2018 data presented in this chapter. This study has added further confidence in the earlier work, and the findings are most likely to be repeatable in future years.

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Table 1: Representative construction items for *citiBLOC* (Langston, 2014; 2016)

Item	Standard Description		Unit	Quantity (weighting)	Local Currency (ex-tax)
Material *(supply only including CBD delivery)*					
A	32 MPa ready-mixed concrete	(1 m^3 = 35.31 cu. feet)	m^3	45	11,144
B	Steel in 250 x 25.7kg/m 'I' beam	(17.3 lb/foot)	t	6.8	9,350
C	10mm clear tempered glass	(1 m^2 = 10.76 sq. feet)	m^2	44	10,472
D	13mm thick gypsum plasterboard	(½" thick)	m^2	1,300	10,140
E	100 x 50mm sawn softwood stud	(1 m = 3.28 feet)	m	2,750	9,873
Labour *(charge-out rate including on-costs)*					
F	Electrician		hr	150	9,900
G	Carpenter		hr	185	10,915
H	Painter		hr	200	10,400
I	Unskilled labour		hr	275	10,863
Plant *(third party hire rate including operator and fuel)*					
J	50 t mobile crane		day	5	10,200
				average price per item (i.e. 1 citiBLOC):	**10,326**

SYDNEY, AUSTRALIA (2012)

Current Market Conditions: ☑ very competitive (low profit) ☐ normal ☐ overheated (high profit)

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Table 2: Surveyed locations (Turner and Townsend, 2018)

City	Country	Currency	Expatistan^
Amsterdam*	The **Netherlands**	EUR	0.89
Bangalore**	Republic of **India**	INR	0.67
Beijing	People's Republic of **China**	CNY	0.81
Belfast	**United Kingdom**	GBP	0.75
Birmingham	**United Kingdom**	GBP	0.79
Bogotá	Republic of **Columbia**	COP	0.65
Brisbane	Commonwealth of **Australia**	AUD	0.85
Buenos Aires	Argentine Republic (**Argentina**)	ARS	0.63
Dar es Salaam	United Republic of **Tanzania**	TZS	0.67
Doha*	State of **Qatar**	QAR	0.92
Dubai* / Abu Dhabi	**United Arab Emirates**	AED	0.88
Dublin*	Republic of **Ireland**	EUR	1.00
Edinburgh	**United Kingdom**	GBP	0.81
Ho Chi Minh City*	Socialist Republic of **Vietnam**	VND	0.64
Hong Kong*	**Hong Kong** SAR, People's Republic of China	HKD	1.04
Houston	**United States** of America	USD	0.78
Istanbul	Republic of **Turkey**	TRY	0.62
Jakarta	Republic of **Indonesia**	IDR	0.63
Johannesburg*	Republic of **South Africa**	ZAR	0.70
Kampala*	Republic of **Uganda**	UGX	0.65
Kigali	Republic of **Rwanda**	RWF	0.63
Kuala Lumpur*	**Malaysia**	MYR	0.64
London*	**United Kingdom**	GBP	1.08
Madrid	Kingdom of **Spain**	EUR	0.74
Melbourne	Commonwealth of **Australia**	AUD	0.88
Moscow*	**Russia**n Federation	RUB	0.67
Munich**	Federal Republic of **Germany**	EUR	0.83
Muscat*	Sultanate of **Oman**	OMR	0.70
Nairobi	Republic of **Kenya**	KSH	0.67
New York City	**United States** of America	USD	1.10
Paris	French Republic (**France**)	EUR	0.95
Perth	Commonwealth of **Australia**	AUD	0.83
San Francisco**	**United States** of America	USD	1.16
Santiago	Republic of **Chile**	CLP	0.69
Säo Paulo*	Federative Republic of **Brazil**	BRL	0.68
Seattle	**United States** of America	USD	0.94
Seoul*	Republic of Korea (**South Korea**)	KRW	0.78
Shanghai*	People's Republic of **China**	CNY	0.74
Singapore*	Republic of **Singapore**	SGD	0.94
Southampton	**United Kingdom**	GBP	0.76
Sydney*	Commonwealth of **Australia**	AUD	1.00 (base)
Tokyo*	**Japan**	JPY	0.90
Toronto*	**Canada**	CAD	0.85
Warsaw*	Republic of **Poland**	PLN	0.64
York	**United KIngdom**	GBP	0.78
Zurich	Swiss Confederation (**Switzerland**)	CHF	1.14

* cities common to Turner and Townsend (2013)
** ditto, but similar city (e.g. Los Angeles replaced with San Francisco)
^ Expatistan is a broad-based 'cost of living' index (accessed 2 June 2018)

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Table 3: Coefficients of variation (average cost/m^2)

Building type (Turner and Townsend, 2013; 2018)	Common (n=23) % (USD)	Common (n=23) % (PPP)	Extended (n=46) % (USD)	Extended (n=46) % (PPP)
Residential				
Individual detached/terrace house medium standard	67	**46**	61	**43**
Individual detached house prestige	77	**53**	67	**47**
Townhouses medium standard	66	**44**	58	**42**
Apartments low rise medium density	59	**34**	55	**36**
Apartments high rise	57	**31**	54	**34**
Aged care/affordable units	76	**54**	63	**46**
Commercial				
Offices - business park	52	**24**	52	**30**
CBD offices - up to 20 floors medium (A-Grade)	57	**22**	56	**25**
CBD offices - high rise prestige	56	**24**	54	**24**
Industrial				
Warehouse/factory units - basic	59	**48**	53	**45**
Large warehouse distribution centre	52	**36**	47	**37**
High tech factory/laboratory	57	**32**	53	**36**
Retail				
Large shopping centre including mall	56	**29**	51	**29**
Neighbourhood incl. supermarket	57	**33**	54	**35**
Prestige car showroom	54	**39**	52	**37**
Hotels				
3 star travellers	45	**26**	42	**27**
5 star luxury	40	**25**	40	**30**
Resort style	45	**42**	40	**39**
Hospitals				
Day centre (including basic surgeries)	57	**41**	50	**34**
Regional hospital	63	**40**	59	**34**
General hospital (e.g. city teaching hospital)	65	**44**	55	**36**
Schools				
Primary and secondary	55	**35**	52	**35**
University	54	**26**	52	**31**
Carparks				
Multi storey above ground	53	**34**	48	**33**
Multi storey below ground	73	**47**	63	**42**
Airports				
Domestic terminal, full service	49	**43**	42	**33**
Low cost carrier, basic service	48	**42**	40	**32**
Proportion lowest CoV (%)	0.00	**100.00**	0.00	**100.00**

***bold** figures indicate lowest CoV*

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Table 4: Coefficients of variation (labour, material and plant)

Item (Turner and Townsend, 2013; 2018)	Common (n=23) % (USD)	Common (n=23) % (PPP)	Extended (n=46) % (USD)	Extended (n=46) % (PPP)
Labour (cost/hour)				
Group 1 tradesman (e.g. plumber/electrician) #	98	**69**	91	**62**
Group 2 tradesman (e.g. carpenter/bricklayer) #	96	**66**	89	**59**
Group 3 tradesman (e.g. carpet layer/tiler/plasterer) #	92	**64**	89	**59**
General labourer #	97	**70**	97	**65**
Site foreman	89	**57**	87	**54**
Proportion lowest CoV (%)	0.00	**100.00**	0.00	**100.00**
Material (cost/unit)				
Concrete 30 MPa (m^3) #	**36**	46	**35**	43
Reinforcement bar 16mm (tonne)	**26**	34	**23**	34
Concrete block 400 x 200mm (thousands)	81	**63**	78	**57**
Standard brick (thousands)	**62**	65	**57**	59
Structural steel beams (tonne) #	35	**35**	36	**34**
Glass pane 10mm tempered (m^2) #	51	**47**	47	**41**
Softwood timber for framing 100 x 50mm (m) #	44	**42**	**38**	46
13mm plasterboard (m^2) #	47	**36**	44	**41**
Emulsion paint (litre)	54	**53**	**56**	80
Copper pipe 15mm (m)	**49**	51	**50**	55
Copper cable (3C+E) 2.5mm PVC (m)	87	**83**	**77**	77
Proportion lowest CoV (%)	36.36	**63.64**	**63.64**	36.36
Plant (cost/day)				
Hire 50 tonne mobile crane + operator #	51	**24**	54	**22**
Proportion lowest CoV (%)	0.00	**100.00**	0.00	**100.00**

 # items are used to construct citiBLOC PPP
***bold** figures indicate lowest CoV*

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Table 5: Coefficients of variation (composite work items)

Item (Turner and Townsend, 2013; 2018)	Common (n=23) % (USD)	Common (n=23) % (PPP)	Extended (n=46) % (USD)	Extended (n=46) % (PPP)
Excavate basement (m^3)	86	**76**	76	**67**
Excavate footings (m)	68	**60**	68	**56**
Concrete in slab (m^3)	36	**33**	40	**28**
Reinforcement in beams (tonne)	**28**	34	**28**	31
Formwork to soffit of slab (m^2)	77	**44**	71	**45**
Blockwork in wall (m^2)	68	**35**	76	**37**
Structural steel beams (tonne)	40	**31**	44	**31**
Pre-cast concrete wall (m^2)	**42**	60	61	**57**
Curtain wall glazing including support system (m^2)	52	**32**	59	**35**
Plasterboard 13mm thick to stud wall (m^2)	51	**45**	51	**43**
Single solid core door including frame/hardware (no.)	**53**	60	55	**54**
Painting to walls, primer + two coats (m^2)	60	**47**	54	**43**
Ceramic tiling (m^2)	48	**25**	57	**28**
Vinyl flooring to wet areas (m^2)	**26**	44	**39**	51
Carpet medium tufted (m^2)	**35**	56	**33**	57
Lighting installation (m^2)	48	**41**	53	**48**
Copper pipe 15mm to wall (m)	62	**38**	54	**30**
Fire sprinklers (m^2 serviced area)	61	**38**	54	**39**
Air conditioning including main plant (m^2 serviced area)	50	**30**	53	**31**
Proportion lowest CoV (%)	26.32	**73.68**	15.79	**84.21**

***bold** figures indicate lowest CoV*

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Table 6: Average cost/m^2 (various conversion methods, n=23)

City	Local Currency	citiBLOC	L+M	Composite	Big Mac	Currency
Expensive (upper quartile)						
San Francisco	3,488	3,303	3,473	3,214	3,897	4,569
London	2,518	4,546	4,356	3,996	4,657	4,458
Hong Kong	29,521	5,317	**4,720**	4,267	^**8,496**	**4,958**
Dublin	2,513	4,129	3,172	4,030	3,754	3,919
Sydney (base)	3,311	3,311	3,311	3,311	3,311	3,311
Singapore	2,982	4,174	3,465	3,470	3,034	2,960
Mid-range (middle quartile)						
Doha	7,919	5,289	3,881	3,424	3,894	2,850
Tokyo	313,370	4,103	4,010	**6,007**	4,865	3,698
Amsterdam	2,114	4,308	3,969	3,063	3,158	3,298
Dubai/Abu Dhabi	6,877	**5,408**	3,687	3,354	2,898	2,455
Toronto	3,131	3,318	3,034	3,846	2,820	3,205
Munich	2,019	3,523	3,089	3,321	3,016	3,149
Seoul	1,965,743	4,503	4,206	4,208	2,636	2,362
Shanghai	5,596	3,687	2,153	2,253	1,619	1,145
Johannesburg	13,380	2,454	1,669	2,994	2,631	1,452
Muscat	600	5,285	3,131	3,607	3,145	2,014
Säo Paulo	4,767	3,896	3,080	3,192	1,705	1,934
Good value (lower quartile)						
Bangalore	46,225	4,200	2,188	2,142	**1,515**	**939**
Moscow	72,802	3,703	3,316	2,337	3,304	1,633
Kampala	4,241,835	2,943	**1,299**	2,967	2,319	1,525
Kuala Lumpur	4,366	3,075	1,890	2,913	2,862	1,451
Warsaw	3,960	3,203	2,675	2,764	2,313	1,526
Ho Chi Minh City	19,029,238	**2,437**	1,620	**2,041**	1,727	1,093
	CoV (%)	***22.38***	*30.09*	*25.71*	*45.50*	***46.00***
	Range	***2,971***	*3,421*	*3,966*	***6,981***	*4,019*

^ *Big Mac price in HK is a clear outlier* **bold** *figures indicate highest and lowest cost/m^2, CoV or range*

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Table 7: Average cost/m^2 (various conversion methods, n=46)

City	Local Currency	citiBLOC	L+M	Composite	Big Mac	Currency
Expensive (upper quartile)						
San Francisco	3,488	3,303	3,473	3,214	3,897	4,569
Zurich	3,434	2,988	2,732	3,328	3,117	4,591
New York City	3,644	3,080	3,289	2,823	4,072	4,773
London	2,518	4,546	4,356	3,996	4,657	4,458
Hong Kong	29,521	5,317	**4,720**	4,267	^**8,496**	**4,958**
Dublin	2,513	4,129	3,172	4,030	3,754	3,919
Sydney (base)	3,311	3,311	3,311	3,311	3,311	3,311
Paris	2,095	4,096	3,750	3,262	3,267	3,267
Singapore	2,982	4,174	3,465	3,470	3,034	2,960
Seattle	2,937	2,972	3,278	2,816	3,282	3,848
Doha	7,919	5,289	3,881	3,424	3,894	2,850
Tokyo	313,370	4,103	4,010	**6,007**	4,865	3,698
Mid-range (middle quartile)						
Amsterdam	2,114	4,308	3,969	3,063	3,158	3,298
Dubai/Abu Dhabi	6,877	**5,408**	3,687	3,354	2,898	2,455
Melbourne	2,941	2,919	2,883	3,086	2,941	2,941
Toronto	3,131	3,318	3,034	3,846	2,820	3,205
Brisbane	2,935	3,268	3,103	3,074	2,935	2,935
Munich	2,019	3,523	3,089	3,321	3,016	3,149
Perth	2,733	3,239	3,255	3,588	2,733	2,733
Edinburgh	1,830	4,196	3,878	4,090	3,384	3,239
Beijing	5,858	3,822	2,273	2,384	1,694	1,199
Birmingham	1,853	4,180	4,070	4,108	3,428	3,281
York	1,831	4,102	4,004	4,085	3,386	3,241
Houston	2,367	2,925	2,865	2,858	2,645	3,101
Seoul	1,965,743	4,503	4,206	4,208	2,636	2,362
Southampton	2,047	4,063	3,960	3,830	3,785	3,623
Belfast	1,629	4,569	4,215	4,475	3,013	2,884
Madrid	1,728	3,691	3,273	3,650	2,581	2,695
Shanghai	5,596	3,687	2,153	2,253	1,619	1,145
Johannesburg	13,380	2,454	1,669	2,994	2,631	1,452
Muscat	600	5,285	3,131	3,607	3,145	2,014
Santiago	1,7017,832	4,106	2,847	3,038	2,310	2,195
Säo Paulo	4,767	3,896	3,080	3,192	1,705	1,934
Bangalore	46,225	4,200	2,188	2,142	1,515	**939**
Good value (lower quartile)						
Moscow	72,802	3,703	3,316	2,337	3,304	1,633
Dar es Salaam	2,177,070	2,378	1,602	2,904	**1,468**	1,270
Narobi	90,426	**1,939**	1,247	2,899	1,875	1,150
Kampala	4,241,835	2,943	1,299	2,967	2,319	1,525
Bogatá	3,674,074	2,555	1,769	2,362	1,989	1,603
Kuala Lumpur	4,366	3,075	1,890	2,913	2,862	1,451
Warsaw	3,960	3,203	2,675	2,764	2,313	1,526
Ho Chi Minh City	19,029,238	2,437	1,620	**2,041**	1,727	1,093
Jakarta	12,620,370	3,722	2,734	3,822	2,083	1,225
Buenos Aires	24,626	4,039	2,051	4,871	1,937	1,702
Kigali	1,067,571	2,779	**1,194**	2,122	2,668	1,620
Istanbul	3,264	3,069	2,466	2,955	1,791	1,094
	CoV (%)	***22.39***	*30.34*	*23.28*	*39.27*	***43.51***
	Range	***3,469***	*3,526*	*3,966*	***7,028***	*4,019*

^ Big Mac price in HK is a clear outlier ***bold*** *figures indicate highest and lowest cost/m^2, CoV or range*

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Table 8: Comparison summary (various conversion methods)

Method		CoV	Range	Compared to Base
Common (n=23)				
L+M		30.09%	3,421	3.32%
Composite		25.71%	3,966	19.78%
citiBLOC (preferred)		**22.38%**	**2,971**	**-10.27%**
Big Mac (not recommended)		45.50%	**6,981**	**110.84%**
Currency (not recommended)		**46.00%**	4,019	21.38%
	Maximum target	^24.23%	0	0.00%
Extended (n=46)				
L+M		30.34%	3,526	6.49%
Composite		23.28%	3,966	19.78%
citiBLOC (preferred)		**22.39%**	**3,469**	**4.77%**
Big Mac (not recommended)		39.27%	**7,028**	**112.26%**
Currency (not recommended)		**43.51%**	4,019	21.38%
	Maximum target	^22.78%	0	0.00%

shaded *figures indicate lowest values and* ***bold*** *figures indicate highest values*

^ mean of CoV across the five conversion methods for each city

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Table 9: *citiBLOC* summary (by quartile)

Quartile		CoV	Range	Compared to Base
Common dataset (n=23)				
Expensive (upper quartile)		18.56%	2,014	-39.17%
Mid-range (middle quartile)		22.23%	2,954	-10.79%
Good value (lower quartile)		18.88%	1,763	-46.76%
	Mean	19.89%	2,244	-32.24%
Extended dataset (n=46)				
Expensive (upper quartile)		21.10%	2,345	-29.18%
Mid-range (middle quartile)		18.46%	2,954	-10.79%
Good value (lower quartile)		20.75%	2,100	-36.58%
	Mean	20.10%	2,466	-25.51%

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Common (n=23) Extended (n=46)

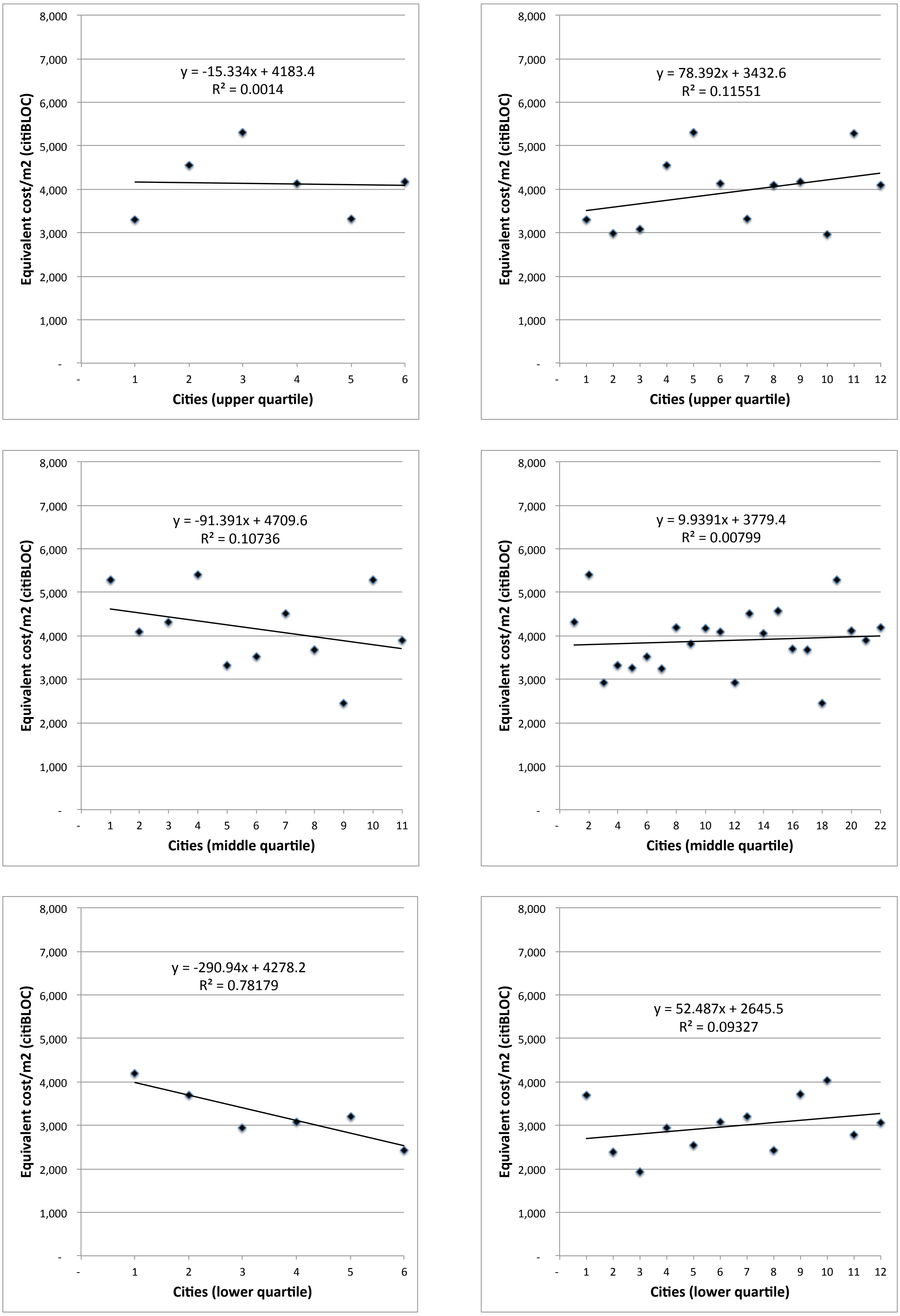

Figure 1: Regression analysis of equivalent cost/m^2 (by quartile)

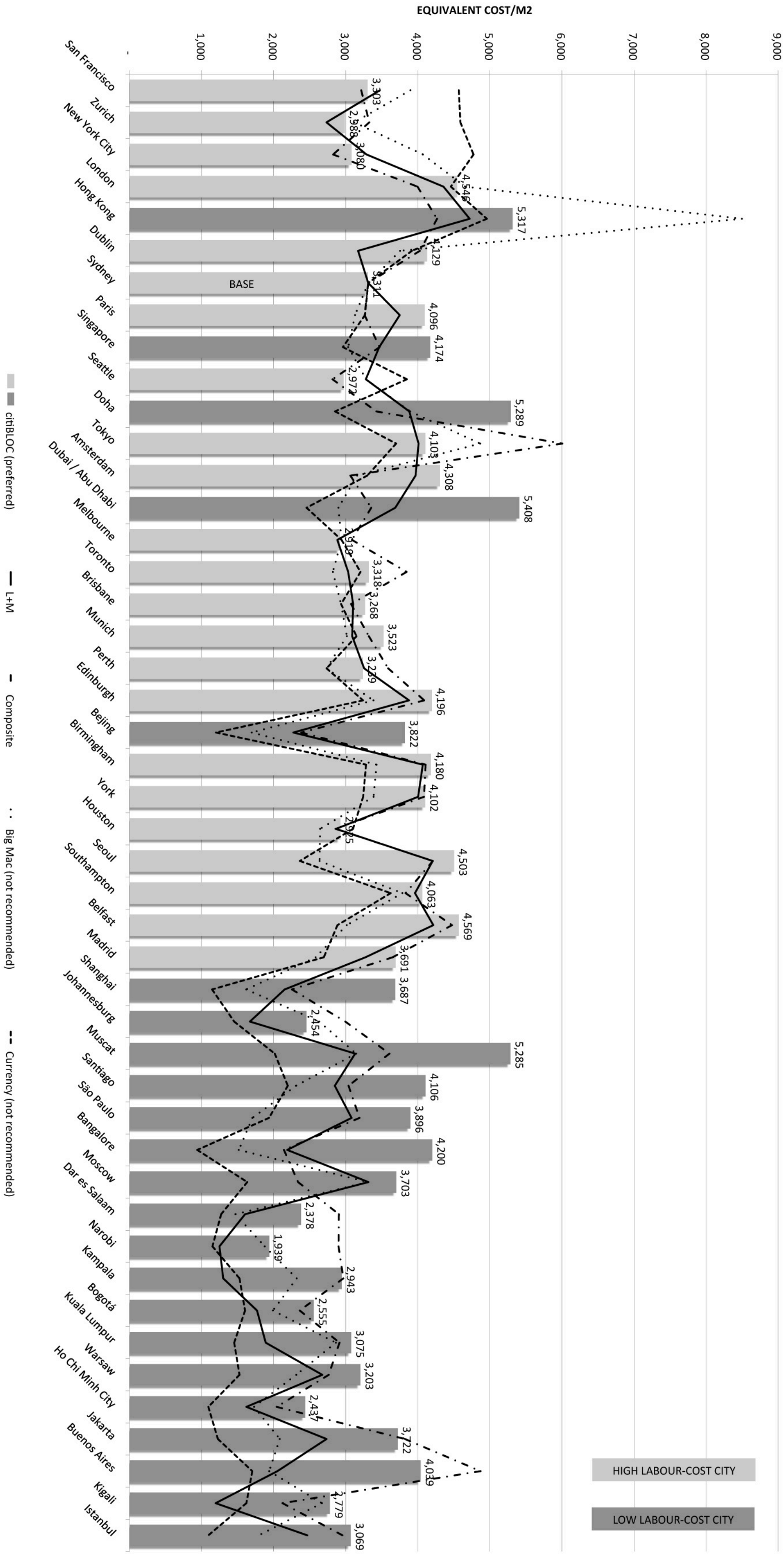

Figure 2: International cost benchmarking (various conversion methods, n=46)

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